

Remarks

The various rejections set forth in the Office Action are discussed below under corresponding or appropriate headings.

Initial Comments

At the outset, it is noted the last Office Action is the eighth Office Action issued by the Examiner. In addition, the last Office Action is the second Office Action that has been issued since an agreement was reached during an interview conducted on March 11, 2005. Notwithstanding, the Examiner continues to maintain rejections which were thought to have been resolved during the interview.

In particular and as discussed below, the Examiner appears to be construing certain language of claim 68 in a manner inconsistent with what was agreed upon during the interview. In fact, it was the Examiner who suggested amending claim 68 to refer to a "discrete" film of non-conducting material to define over structures where a continuous layer extends not only over the sides but also the top of a conductive line.

Rejection of Claims based on Masaaki

Claims 59-65, 67, 72 and 73 were rejected as being anticipated by Masaaki (JP 62-005643). The rejection is premised on the conclusion that Masaaki discloses air gaps that are of uniform width. Although the drawings appear to show air gaps of uniform width, Masaaki has not been found to contain any disclosure as to how this might be accomplished. As is well settled, a patent claim cannot be anticipated by a prior art reference if the allegedly anticipatory disclosures cited as prior art are not enabled. Consequently, the rejection is improper and should be withdrawn.

The undersigned has been provided with the following explanation of a typical example of the invention disclosed in Masaaki:

Examples

Below, we explain the detail of typical example on this invention refer to Figure 1. Figure 1 is a diagram of cross section in case that this invention is applied to a conventional example, showing in Figure 3. In Figure 1, there are air gaps, 6 and 7, between wires, 3, 4 and 5. Typically, SiO₂ is used as dielectric materials 2. In case that there are air gaps between adjacent two wires, we can regard the capacity between two wires as a

series connection of the capacity of between one wire and air gap, air gap itself and between air gap and another wire. As the dielectric constant of dielectric material, which is air, in air gaps is about one forth of SiO_2 , which is a dielectric material used in another portion, the capacity between wires can be reduced with make air gaps like this invention. For example, the capacity of adjacent wires with air gap which size is $1/3$ of length of adjacent wires is a half of no air gap. Larger the size of air gap is, smaller the capacity of adjacent wires. And, as the capacity between wire and substrate is almost all constant and independent to air gap, the portion of the capacity between adjacent wires to total wire capacity becomes smaller compared with conventional case. Consequently, a deviation of voltage to be induced by the mutual capacity of adjacent wires is reduced and it makes operation errors less and operation margin larger compared with conventional case.

It is easy to make air gap in the dielectric material 2, between adjacent wires. In the case that the mutual capacity of adjacent wires, in other words, that adjacent wires are close together and wires are thicker, the air gap is easily construct with CVD techniques after constructing wires. But, in this case, the bottom of air gap is above level the bottom of wires. To construct air gaps the bottom level of which is under the bottom of wires like Figure 1, you may etch away a certain amount of dielectric materials, 2, between wires which are 3, 4 and 5, and then deposit dielectric materials with CVD.

One thing that is evident is that CVD techniques are used to apply the SiO_2 layer 2 in which the air gaps are formed. CVD, however, typically gives rise to teardrop shape air gaps as shown in Machida, Gaw et al. (US 6,303,464), Fulford, Jr. et al. (US 6,376,330), Fulford, Jr. et al. (US 5,759,913) and Avanzino et al. (5,776,834). Thus, it is not seen how a CVD process can form air gaps as shown in the drawings of Masaaki. In the absence of a teaching as to how such air gaps can be formed following the teachings of Masaaki, Masaaki can not be relied upon as an anticipatory reference. Therefore, the rejection should be withdrawn.

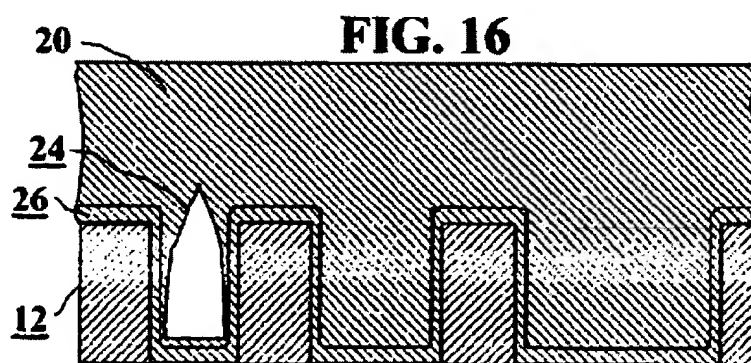
Regarding claims 72 and 73, the Examiner relies on Avanzino rather than Masaaki. The statement of the rejection, however, makes no reference to Avanzino. The record is therefore unclear as to why claims 72 and 73 have been rejected as being anticipated. Clarification is requested. In addition, further comment on the

rejection as it applies to claims 72 and 73 does not appear to be appropriate or necessary until the rejection is clarified.

Rejection of Claims based on Avanzino

Claims 68-70 were rejected as being anticipated by or unpatentable over Avanzino. In his supporting remarks, the Examiner states that he is construing "a discrete film of non-conducting material that does not extend over the conductive material beyond the air gap" to mean "that film extend to a greater distance/height than gap". This interpretation, however, in effect reads the words "over the conductive material" out of the claim.

The Examiner considers the layer 26 to be a "discrete film" as set forth in claim 68. As previously pointed out, the layer 26, however, extends over the conductive material as well as the sides of the conductive line. This can be clearly seen in FIG. 16 (reproduced below), where the layer 26 extends vertically along the side of the conductive line 12 and then horizontally over the conductive line. The term "discrete" was added to address the Examiner's contention that any part of the layer can be isolated and considered to be a film as set forth in the claim. Consequently, a portion of the layer 26 is not a discrete layer as it is integral with other portions of the layer 26. Thus, one must look at the entire layer 26 to determine whether or not it extends over the conductive material beyond the air gap. As can be seen in FIG. 16, layer 26 does not meet the limitation of claim 26 that the discrete film not extend over the conductive material beyond the air gap.



For at least the foregoing reasons, the rejections of claims 68-70 is improper and should be withdrawn.

Claims 66 and 74

Claims 66 and 74 were rejected as being unpatentable over Masaaki. The above comments concerning Masaaki regarding enablement are equally if not more applicable to this rejection, and therefore this rejection should be withdrawn. That is, it is not seen how the CVD process of Masaaki can obtain the features of claims 66 and 74.

Claims 71 and 74

Claims 71 and 74 were rejected as being unpatentable over Avanzino. For at least the same reasons given above in respect of claim 68, the rejection of claim 71 should be withdrawn. Regarding claim 74, the skilled person will appreciate that the provision of air gaps having upper sides that are parallel to the planar extent of the substrate will provide performance characteristics of the semiconductor device that are different from those afforded by the air gaps taught by Avanzino. The rejection of claim 74 should therefore also be withdrawn.

Claims 68-71

Claims 68-71 were rejected as being unpatentable over Masaaki in combination with Avanzino. As above discussed, Avanzino does not disclose a discrete film of non-conducting material that does not extend over the conductive material beyond the air gap. Likewise, Masaaki does not disclose a discrete film of non-conducting material that does not extend over the conductive material beyond the air gap. The rejection, therefore, should be withdrawn for at least these reasons.

Request for Interview

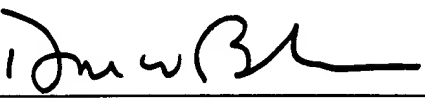
If the Examiner intends to maintain the rejections, the Examiner is requested to phone the undersigned to schedule an interview with the Examiner and also the Examiner's SPE. As above-noted, eight Office Actions already have been issued in this application. This piecemeal and lengthy prosecution of the application needs to be expeditiously brought to a close.

Conclusion

This application is believed to be in condition for allowance and an early issuance of a notice of allowance is earnestly solicited.

Respectfully submitted,

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CERTIFICATE OF MAILING

I hereby certify that this paper (along with any paper or thing referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Date: December 22, 2005


Don W. Bulson

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